

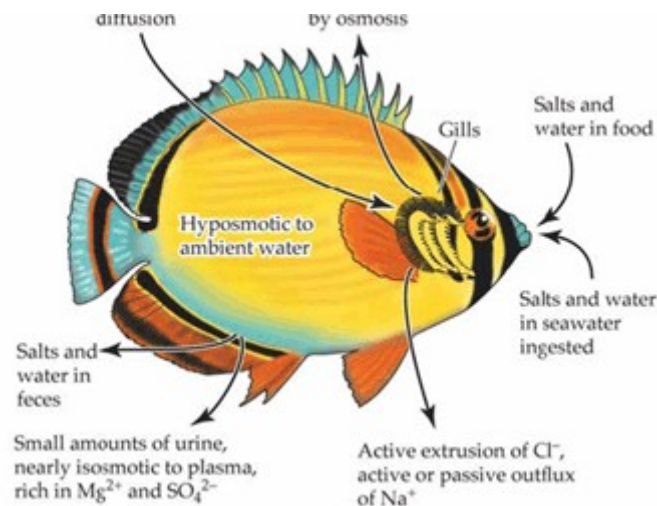
SPAWNING MIGRATION OF PEARL MULLET

The pearl mullet is a migratory fish species that lives in Lake Van except for the spawning season. Fish that can carry out their reproduction and feeding activities in different habitats are called diadromous fish. Such diadromous fish as European eels which feed on freshwaters but migrate to the seas for spawning are called catadromous fish. Such fish as salmon and pearl mullets which feed on salty or brackish waters but migrate to freshwaters for spawning are called anadromous fish. And such species which migrate within the seas for feeding and spawning are called oceanodromous fish. In short, fish are categorized under various names depending on where their feeding and reproduction activities take place. As emphasized above, the pearl mullet is an anadromous fish species since it feeds on salty-alkaline waters of Lake Van but reproduces in freshwaters. Even though it is named as “mullet”, it is in fact a member of the Cyprinidae family. In other words, it is a freshwater fish. But some members of *Chalcalburnus* genus including the pearl mullet can also survive in salty and freshwater habitats. For example, the *Chalcalburnus chalcoides* sp, commonly known as Aral Shemaya, is a fish species inhabiting the Aral Sea which migrates to rivers around during the spring as similar to the pearl mullet. The main reason for their migration is because they are originally freshwater fish. Although the pearl mullet too lives in salty-alkaline waters, it cannot lay eggs in such an environment. Therefore, it migrates to rivers in big shoals at the spring.

Preparative Stage for Migration and Ionic Regulation

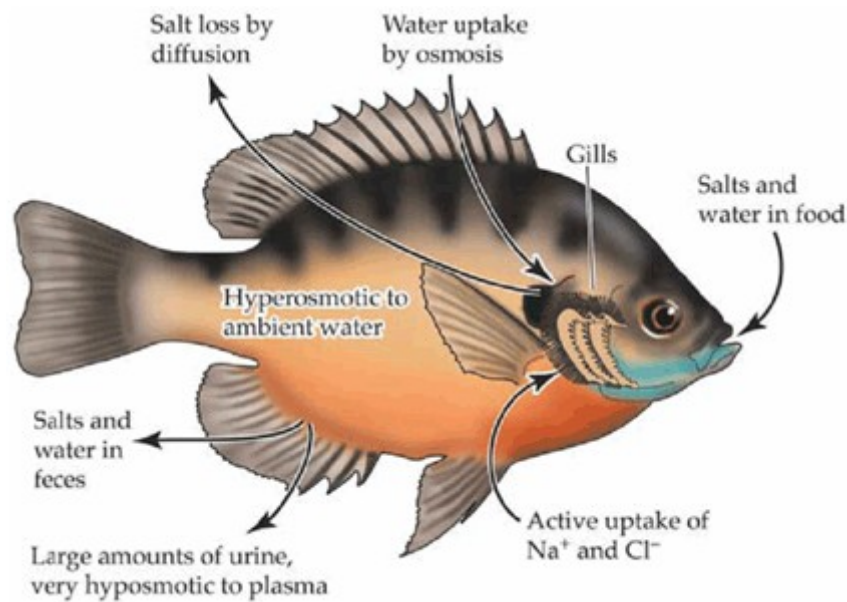
Although some become adults when they are two years old, the pearl mullets in Lake Van have their reproductive ability at the age of 3 on the average. Depending on climate conditions as well, those fish mature enough to reproduce usually migrate to

where rivers flow into the lake by mid-March. They gather in such areas because they need to regulate ion density in their bodies in accordance with freshwater levels. Fish cannot move directly from salty-alkaline to fresh waters. If it does, it goes into shock due to different levels of ion density and dies shortly after. This is why those fish that migrate between salty and fresh waters need to wait shortly to finalize their physiological adaptation. This period of adaptation is called “osmoregulation” in ichthyology. The osmoregulation process varies significantly between sea and freshwater fishes. This variation can be clearly seen as in the following:



Osmoregulation in marine fish

Ion density of marine fish is lower than the level of ion density in the sea. In other words, their bodies have less density when compared with the environment they live in. While ions are being transferred from high to low density areas by diffusion, some dehydration occurs through osmosis. Such a continuous dehydration causes fish to urinate only a little. To compensate the outgoing body liquid both by dehydration and urination, fish needs to drink sea water. Ion loss through gills continues both actively and inactively. If this marine fish is placed in freshwater immediately after being taken from its marine environment, it will die instantly.



Osmoregulation in freshwater fish

The situation is just the opposite for freshwater fish. Ion density in the body of freshwater fish is higher than that of the surrounding environment. Since ions are being transferred from high to low density areas by diffusion, fish loses ions through diffusion on a regular basis. The body liquid on the other hand increases constantly by osmosis due to incoming water through the skin. To eliminate excess water in the body, fish urinates regularly. If freshwater fish is placed in saltwater immediately after being taken from its original environment, it will die instantly as marine fish does in a similar way.

Therefore, those fish migrating between saltwater and freshwater for feeding and reproduction purposes need to wait shortly for ionic regulation at where saltwater flows into freshwater. Their migration cannot take place otherwise.

As an inhabitant of salty-alkaline waters of Lake Van , the pearl mullet too needs to wait shortly at river mouths for ionic regulation both on the way to freshwaters in the springtime to reproduce and on the way back to the lake. The waiting period at river

mouths might range from one week to a month depending on climate conditions.

Migration and spawning

After ionic regulation, fish start moving to rivers as the water temperature rises over 13 °C. Once in the river, it searches a likely ground for spawning. The spawning migration undertaken to avoid enemies and to lay eggs in a safer locality usually becomes more hectic from sunset to sunrise. But it also continues during the day. The pearl mullet does not feed on any food items during the migration. It spends the whole energy available for reproduction purposes. Those fish already moved to the river and found a likely spawning ground will return to the lake immediately. Those cannot find a good spawning ground continue to move upstream. To lay eggs, the best place is where there is a low level of flow and is also covered with pebble, sand and aquatic plants at the bottom. After identifying a good spawning spot, the female is generally followed by two males. Males tend to stay longer at spawning grounds than females. Waving its caudal fin and approaching its abdomen to pebbly, sandy ground, the female lays eggs. One of the male fish discharges sperma over the eggs and so the fertilization is finalized. Fish are too weak before laying eggs. In some cases they are seen as floating with the flow almost dazed and unconscious.

Such construction units as irrigation regulators, water inlet ditches, and protective sets for bridge piers built over rivers surrounding the lake are such barriers for fish when migrating to springs. It is therefore impossible to determine the longest distance a pearl mullet can travel for spawning. The longest course they take for spawning is on the Bendi Mahi Stream. Fish can move up to 23 km from the river mouth where the DSI (The General Directorate of State Hydraulic Works) irrigation regulator is installed. For now, we may claim that 23 km is the longest distance the

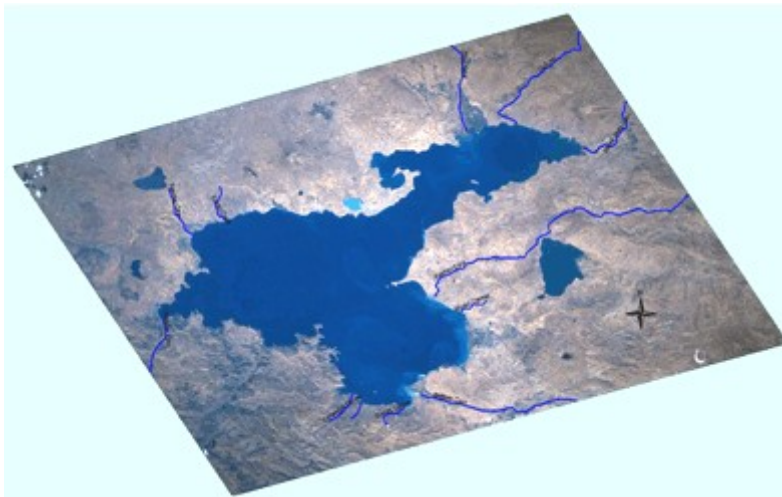
pearl mullet can travel for spawning migration. If such construction units reorganized in a way not to block fish migration, then it would be possible to provide data on the maximum distance the pearl mullet can travel.

After laying eggs, adult fish start their journey to return to the lake. Since fish does not feed on any food items during spawning migration, it should return to the lake as soon as possible. The time period fish usually stays in the stream may vary between 1-7 days still depending on environmental conditions. Under such conditions, it needs to wait shortly for physiological adaptation at river mouths where freshwater flows into the lake. After regulating the ion density within their bodies according to the lake level, adult fish move to the lake. During the summer, they take nourishment at a fast pace in those areas of the lake not deeper than 20 m and start getting prepared for spawning migration in the next year.

For spawning migration to start, the water temperature in rivers must reach to 13 °C. As the water temperature rises above 23 °C, the spawning migration comes to an end. Because at 23-24 °C water temperature in rivers, the level of dissolved oxygen decreases critically to 4 mg/l in most cases. At the water temperature above 23 °C, those fish already in the stream start their journey back to the lake immediately after laying eggs without caring too much about the spawning ground. If the rate of flow decreases sharply due to agricultural irrigation on one hand, and the water temperature increases rapidly on the other, fish does not have enough time to return to the lake. As a result of oxygen deficiency, a large number of dead fish at stream beds can be observed. Fish mortality due to old age can be seen when they come to the end of their spawning migration in rivers. When they reach the reproductive maturity at 3 years old, fish continue to their spawning migration until the age of 7 which is also their maximum life span.

Rivers for laying eggs

The pearl mullets lay eggs in a total of 101 rivers including those small streams with much higher water level in the spring than summer. As fish move to rivers with high or low rate of flow to reproduce, their number will vary inherently in relation to the rate of flow. At this point, we need to consider the fact that during the reproduction period the pearl mullet moves to all rivers flowing into the lake. But the primary habitat for the fish to reproduce consists of 12 large rivers in the area. If we take Van as the central point and move from north to west, these rivers can be listed as Morali, Karasu, Bendi Mahi, Deliçay, Zilan, Kumlu, Karmış, Güzelsu, Dereagzı, Güzelkonak, Gevaş and Engilsu Streams.



Main rivers around the Lake Van

Migration and flying fish

Fish struggles hard to defeat both natural and artificial barriers during the migration period. In some cases it can easily overcome small barriers on its way while in some others it struggles desperately to go over the regulator walls 2-3 m high. As a matter of fact, fish migration is one of the most difficult types to follow among that of other animals. This is the reason why thousands of people rush into northern countries

every year to watch the migration of salmon with naked eye. After days of effort all they can see is one or a few salmon moving upward to the waterfall. But in May-June period when pearl mullets migrate to rivers around the lake and struggle so hard to defeat barriers on the way, it is possible to see hundreds of them jumping over the falls at the same time. The Nature Observers Society has already identified observation points to follow the pearl mullet migration and still continues to improve observation techniques in such places.



The effort of the jumping pearl mullet on small barrier at the Erciş-Deliçay Balık Bendi

Spawning migration and threatening factors

The pearl mullet faces a series of dangers during the spawning migration. Although some are due to natural reasons, the majority of such dangers are caused by humans.

Aridity and water misuse: Due to such factors as being located at a semiarid climate region, decreasing number of forests in recent years, etc., there are irregular rates of flow at rivers in our country. Since no preventive measures have been taken so far against aridity we experience at a period of almost every 7 years, the

biological diversity in our rivers has been negatively influenced. Although there is not an intensive agricultural activity around Lake Van , we still experience some problems at ecologically allocating water resources during the pearl mullet migration due to inefficient use of water, lack of water supply networks or at least lack of their good care periodically, etc. Knowing almost nothing about the right irrigation techniques, local farmers tend to think incorrectly that “the more water, the more fertility”, and they want to transfer the water available at stream beds into irrigation channels or drains for agricultural purposes. This sometimes leads the pearl mullet to terminate its spawning migration earlier than it should be, and sometimes even to face death at stream beds due to oxygen deficiency. The average flow rate of Bendi Mahi Stream which is 20 m³/s in May has fallen into 6 m³/s during the season of drought in 2000. On May 20th, 2000 the total amount of water available at all stream beds had been transferred into irrigation channels for agricultural purposes, and as a result, approximately 10 tons of pearl mullets and millions of fry fish and eggs were burned to death under the sunlight.

To prevent such a situation, a scientific study has been carried out on ecological water allocation, and the outcome has been interpreted in a way to ensure its practicality. According to it, 1/3 of the total flow should be left at stream beds during the reproduction period. The Office of the Governor in Van announced officially the essentials of water allocation which later had served as a proper basis for implementation. But some irresponsible agricultural activities and those people encouraged by the lack of official control still cause a decrease in the rate of flow over time which in turn lead the pearl mullet to suffer during the reproduction period.

Discharge of sand from stream beds: Sand used for construction at residential areas around the lake is discharged either along the coasts (Gevaş, Tatvan and

Ahlat) or at stream beds of Lake Van . Such a discharge negatively affects the pearl mullet in four different ways as follows: First, it damages the spawning ground for fish to lay eggs. Second, at reproduction period those eggs emitted in spawning areas are also discharged onto trucks with sand. Third, heavy construction equipments working at stream beds crush out eggs laid in such areas. And fourth, discharge of sand results in finding water which later gets blur due to suspended solids in its structure. When they subside down they prevent the oxygen intake of fish eggs laid at the bottom by enclosing them. Therefore, discharge of sand at stream beds during spawning period is one of the most significant human related factors threatening the reproduction of pearl mullets. Although such activities do not take place at all rivers surrounding the lake, unfortunately it still continues at major reproduction habitats today. There are several barrow pits of sand over Karasu Stream (Van-City Center), Bendi Mahi Stream (Muradiye-Balıkli Local Villages) and Zilan Stream (Erciş-Çelebibağ Town). If we consider 101 rivers in total, the amount of sand discharged is around %3 among them. The harmful effects of sand pits on fish reproduction are beyond dispute. Thus, any discharging of sand at river beds around the lake should be prevented during the fish reproduction season.

Construction units built over rivers: There are various construction units built over almost all major rivers around the lake very close to river mouths. Sometimes they are regulators or water inlet ditches, and sometimes they are protective fall structures for bridge piers. A legal permit should be given by the Ministry of Agricultural and Rural Affairs to prevent any damage on fishery when building such units. It can be issued only after some appropriate measures are taken to prevent such damage. But since there is no effective control mechanism to ensure it, any institution or individual can practice independently without seeking further approval.

The pearl mullet cannot always defeat such barriers on the way during the spawning migration. Even without even a slight chance to lay eggs, clusters of fish before barriers easily become open targets for fishers

As a direct result of an application by the Nature Observers Society to the District Office of Highways, those fall structures around piers of Örene Bridge over Zilan Stream and Ablengez Bridge over Karasu Stream have been corrected in a way not to interfere with the fish migration. As for construction units built over other rivers, there is not any prospect of development at present.

Pollution: Fish spawning is negatively influenced by pollution in rivers around the lake. As water pollution increases, fish cannot move to rivers for reproduction purposes. Especially those rivers around the lake passing through residential areas and those with low rate of flow are under a greater risk of pollution. Some highly polluted streams can be listed as follows: Akköprü Stream-Van City Center, Kurubaş Stream-Van City Center, Morali Stream-Van Organized Industrial Zone, Erciş-Tekevler Stream, Adilcevaz Stream-Adilcevaz Center, Harabeşehir Stream-Ahlat Harabeşehir, Dereağzı Stream-Gevaş Uysal Town and Gevaş Stream-Gevaş Center

Illegal fishing: The most important threat on the reproduction process of pearl mullets is illegal fishing during the spawning migration. It takes place when fish is waiting at river mouths for physiological adaptation or when it moves to rivers for reproduction. According to data taken in 1996, 12 out of 15 tons of total fishery products belong to illegal fishing. Thanks to recent conservation efforts, the figure for illegal fishing has been reduced to 4 tons based on 2005 data.

Some detailed information on illegal fishing can be found at section under the title of

Fishing.

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